

## **REMARKS**

### **INTRODUCTORY REMARKS**

Reconsideration and allowance are respectfully requested. This Amendment is submitted with an RCE.

In the June 16, 2008 final office action, the Examiner rejected all pending claims 1-3, 7-13, 17-23, 25, 29-41, 44-46, and 98-99.

The independent claims are 1 and 40.

In this Amendment, the Applicants recite in the independent claims that the solid oxide has transparency and index of refraction adapted for the photomask in need of additive repair.

The Applicants find support is present for these Amendments throughout the specification including, for example, page 32, lines 14-22 (“...similar overall optical properties (transparency, index of refraction)...”). No new matter is believed present.

Also, the specification is amended as suggested by the examiner. The Applicants respectfully request for sake of efficiency that additional formality changes to the specification be resolved all at one time at, for example, at allowance via Examiner’s Amendment. The Applications believe that with respect to (ix) that the PTO scanning of the application failed to pick up certain letters such as “o” and “e” in several headings. This has been corrected although this appears to be a PTO mistake, not applicants’ mistake.

No new matter is believed added, and the Examiner is requested to contact the undersigned if new matter is deemed present.

### **RESPONSE TO PRIOR ART REJECTIONS**

#### **I. INTRODUCTION**

One substantive issue remains: obviousness.

However, the prior art cited by the Examiner fails to disclose or suggest at least one crucial element in the broadest claims. Moreover, the prior art primary reference directly teaches away. Hence, *prima facie* obviousness is not present.

The claimed invention relates generally to nanoscale additive photomask repair. Photomasks are commonly used in the semiconductor industry. Photomasks continue to become more complex and expensive as device size shrinks well into the nanoscale (e.g., smaller than 100 nm). Hence, a market need exists to be able to repair photomasks which are defectively made. The applicant have invented a fundamentally new approach to solve problems with nanoscale photomask repair.

Two general types of repair are known: additive and subtractive. In additive photomask repair, a defective photomask is provided, and a material is added to the defect to fix the mask. Such repair is not trivial. The material added must be specially formulated to be capable of being deposited and must have suitable optical properties and thickness (e.g., suitable refractive index). Artisans in the past commonly used vacuum and beam processes for additive repair. In contrast, the applicants herein claim a new, non-vacuum, sol-gel approach to additive repair. Moreover, additive repair stands in contrast to the generally easier methods of subtractive repair, wherein material from a defective photomask must be removed. In subtractive repair, no specially formulated material is need. The additive and subtractive processes are not interchangeable. Industry needs better additive repair methods much more than it needs better subtractive repair, and NanoInk has developed a new method to address this need.

Rejected independent claim 1, the focus here, states:

***1. A method for additive mask repair in the semiconductor industry with fine control over lateral dimensions and height comprising:  
providing a defective mask in need of additive repair,  
depositing material to the defective mask by direct write nanolithography from a tip for additive repair, wherein the tip is an atomic force microscope tip and wherein the material coats the tip, and wherein the material is a sol-gel material  
converting the deposited material to a solid oxide, *which has transparency and index of refraction adapted for the defective mask in need of additive repair.**** (Emphases Added)

Independent claim 1 has been finally rejected for only one reason: obviousness. In formulating the obviousness rejection, the Examiner has first relied on six references: Lewis (Applied Physics Letters), Miller (6,270,946), Park (5,871,869), Starodubov (5,972,542), Ukrainczyk (6,253,015), and Mancevski (6,146,227). *See* office action page 4. The Examiner has also issued a supplemental obviousness rejection based on these six references but also adding two references to Mirkin (2003/0162004 and 2004/0142106).<sup>1</sup> *See* office action page 12. However, the two Mirkin references do not cure the problems raised by the initial six reference. Adding more and more references will not help in this context and actually is suggestive of a finding of NON-obviousness.

## II. MISSING ELEMENT

First, no *prima facie* obviousness is present because none of the cited references teach “providing a defective mask in need of additive repair” or “additive mask repair” or a solid oxide material adapted with index of refraction and transparency for the additive repair. Hence, at least one “missing element” is present, and the claimed invention is not arrived at even if the references are combined for sake of argument.

The primary reference Lewis teaches subtractive repair, not additive repair.

The second reference Miller teaches a deposition process which is an alternative to photomask methods. No photomask repair is described.

The third and fourth references, Park and Starodubov, teach a method of manufacturing a photomask, not repair.

The fifth reference Ukrainczyk teaches an optical waveguide.

The final, sixth, reference Mancevski teaches a carbon nanotube MEMS device which can be used generically in any number of applications including generic mask repair. However, the reference does not teach or suggest any particularity with respect to additive repair.

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<sup>1</sup> The Applicants reserve the right to swear behind the two Mirkin references based on the filing dates of this application and the filing dates in Mirkin, although this issue is deemed inapposite for purposes of this Request.

In addition, the two Mirkin references cited in the second rejection also fail to teach these elements.

In view of the large differences between subtractive repair and additive repair – these are non-equivalent methods - the Applicants respectfully submit that this missing element is material and evidence of patentability. Moreover, the differences between the claims and the cited reference do not reflect mere optimization but rather address a recognized difficult problem in the art. The Applicants have already presented literature in the record which confirms that, compared to subtractive repair, additive repair “has proven more difficult.” See Applicants June 4, 2007 Rule 116 Amendment, page 16 and attached reference.

Finally, the Examiner states that US Patent Nos. 5,104,684 (Tao) and 6,197,455 (Yedur) provide additive repair (office action, page 19). However, the Examiner has not cited these references in the rejection and has not indicated how their teachings combine with the primary reference, Lewis, or any other cited reference. These references, moreover, merely state the problem: that cumbersome methods are needed to provide additive repair. Hence, the Examiner commits legal error in resort to these references.

### III. TEACHING AWAY

Moreover, the primary reference Lewis teaches away. A reference must be considered for all that it teaches, disclosures that diverge and teach away from the invention at hand as well as disclosures that point toward and teach the invention. See, for example, *In re Dow Chemical*, 837 F.2d 469 (Fed. Cir. 1988). A reference that teaches away cannot serve to create a *prima facie* case of obviousness.

Lewis teaches a subtractive process which requires use of a very different material than a sol-gel material as presently claimed. One would not use sol-gel material for subtractive repair. Sol-gel materials are reactive materials which condense and upon cure form solid structures. They are not materials to remove matter like an etchant, as Lewis teaches.

In particular, claim 1 requires depositing “a sol-gel material” and “converting the deposited material to a solid oxide.” Whereas applicants claim a solidification step, Lewis teaches the prevention of solidification:

*“Etchant which leaves the pipette forms globules which solidify on the surface. This hinders the writing process. Globule formation and solidification can be prevented by keeping the surface and tip at absolute humidity.” See page 2690, left column, bottom.*

In other words, the deposited materials in the claim and the prior art are totally opposite. In the claim, the materials solidify, whereas in Lewis, the materials are prevented from solidifying. The claim requires use of sol-gel materials which are anathema to Lewis, which teaches a non-solidification system.

The secondary reference Miller also teaches away, directing one skilled in the art to use the process “without using a mask.” See col. 1, lines 42-47. Moreover, the difunctional molecules used in Miller teach away from sol-gel materials as presently claimed as sol-gel materials require network formation which requires more than two functional sites per molecule (e.g., three or four functional, reactive groups are needed to form a solid network.).

Clearly, the Examiner has adopted a hindsight approach in not picking any references which directly relate to additive repair. One of ordinary skill in the art faced with the problems of photomask repair would not turn to these references to solve the problem – particularly a reference like Lewis which teaches etchants and teaches away from solidification processes.

Finally, the Examiner appears to ignore the Applicants’ argument and relies on a selective reading of Lewis and its teaching away (office action, page 18). A contradiction, teaching away is present. Moreover, Lewis does not teach additive repair, and the Examiner has not shown how Lewis itself teaches additive repair.

#### **IV. NO MOTIVATION TO COMBINE REFERENCES**

Finally, no motivation to combine references is present, particularly with respect to Lewis and Miller. Injecting the teachings of Miller into Lewis would destroy Lewis – one cannot do subtractive repair with the materials of Miller. Similarly, injecting the teachings of Lewis into

Miller would destroy Miller – one cannot do a deposition and multilayer process with the materials of Lewis (etchants). Other inability to combine references arises among the six or eight cited references.

#### **V. MISINTERPRETATION**

Respectfully, a key misinterpretation in the Examiner's reasoning in the record to date appears to be an overemphasis on the breadth of the teachings of Lewis and the ease at which the Examiner applies Lewis and other references for additive repair. The Applicants have established the difficulty of additive repair and the Lewis reference is not helpful for additive repair. For example, at the end of the Lewis article (page 2691), a variety of improvements are noted including ink jet printing, altering the tip, including improving the geometry of the tip, and adapting the deposited material with respect to flow, capillary osmosis, lubrication, and wetting properties. However, none of these improvements suggest additive photomask repair which requires that the material be adapted optically to repair the mask. The Examiner has misinterpreted the reference in suggesting that the broad speculations in Lewis would have been applied to solve the very focused issue of additive photomask repair. The Applicants respectfully submit that Lewis is silent about additive photomask repair for a reason – the teachings in Lewis are not applicable to additive photomask repair.

#### **VI. INDEPENDENT CLAIM 40 AND DEPENDENT CLAIMS**

The position taken above with respect to independent claim 1 is similar to that also taken for independent claim 40 except that the preamble is different and that a broader term, scanning probe microscope, is used compared to the AFM in claim 1.

Several dependent claims present particularly important issues for patentability. For example, the prior art does not teach or suggest the high structures of 30 or 45 or more nm, as found in claims 21-24. Lewis does not teach how to build high structures. In addition, claims 98-99 recite exclusion of voltage, and the primary reference suggests use of voltage.

The Applicants incorporate by reference their prior remarks about patentability into this Amendment.

If the Examiner has any questions or comments about the present Amendment, he is invited to contact the undersigned to efficiently resolve any issues.

The Commissioner is hereby authorized to charge any additional fees which may be required regarding this application under 37 CFR §§ 1.16-1.17, or any other provision, or credit any overpayment, to Deposit Account No. 19-0741. Should no proper payment be enclosed herewith, as by a check being in the wrong amount, unsigned, post-dated, otherwise improper or informal or even entirely missing, the Commissioner is authorized to charge the unpaid amount to Deposit Account No. 19-0741.

Respectfully submitted,

Date

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